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Application No.	:	09/928,619
Filed	:	8/13/2001
Inventor(s)	:	James G. Shanahan
Docket No.	:	A1413-US-NP
Confirmation No.	:	7995
Examiner	:	Joseph P Hirl
Art Unit	:	2121
Title	:	FUZZY TEXT CATEGORIZER
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SEP 1 0 2004

PATENT APPLICATION
Attorney Docket No. **A1413-US-NP**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of: James G. Shanahan)
) Art Unit: 2121
Appl. No.: 09/928,619)
) Examiner: Joseph P Hirl
Filed: August 13, 2001)

Title: **FUZZY TEXT CATEGORIZER**

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Respectfully submitted,

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Attorney Docket No. **A1413-US-NP**

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APPEAL BRIEF

Sir:

Appellant respectfully submits this Appeal Brief in the appeal of the present case to the Board of Appeals and Patent Interferences on the Notice dated September 1, 2004.

1. Real Party of Interest

The real party of interest in the present application is the assignee of the present application, Xerox Corporation.

2. Related Appeals and Interferences

There is no related appeal or interference.

3. Status of the Claims

Claims 1-13, 15-22 and 25-29 are pending in this application. These claims were finally rejected in an Office Action mailed June 1, 2004 (hereinafter referred to as the "Office Action"). Of these, claims 1, 11, 22, and 28 are independent claims. An Amendment faxed March 15, 2004 amended claims 1, 5-7, 20-22 and 25; added new claims 27, 28, and 29; and canceled claims 14, 23 and 24.

4. Status of Amendments

It is understood that all amendments to the claims made in an amendment under 37 C.F.R. §1.111 dated March 15, 2004 have been entered and are reflected in the claims forming Appendix A hereto.

An amendment proposed in an amendment after final under 37 C.F.R. §1.116 dated June 25, 2004 was not entered as indicated in an Advisory Action dated July 26, 2004 (herein referred to as the "Advisory Action"), and is therefore not reflected in the claims set forth in Appendix A.

5. Summary of Invention

Appellant's invention concerns two different embodiments for classifying a text object using fuzzy logic. The first embodiment summarized below concerns classification using fuzzy sets and the second embodiment summarized below concerns classification using granule fuzzy sets. The figures referred to below in summarizing the two embodiments of the invention are reproduced in Appendix B of this Appeal Brief.

5.A Summary of Class Fuzzy Set Embodiment

As detailed in Appellant's **Figure 3** (see also Appellant's specification page 7, lines 9-27), the first embodiment for classifying a document using fuzzy logic (as recited in independent claims 1 and 22) involves constructing a *document class fuzzy set* for a text object (see 310, FIG. 3) in order to assign a *class label* to the text object (see 312, FIG. 3).

As detailed in Appellant's **Figure 4** (see also Appellant's specification page 8, lines 16-32), after features are extracted from the text object (see 402, FIG. 4), a document class fuzzy set is constructed (see 405, FIG. 4) by: (a) identifying the frequency of occurrence for each feature in the document (see 406, FIG. 4), (b) normalizing the calculated frequency of occurrence to define a frequency distribution (see 408, FIG. 4), and (c) transforming the normalized frequency distribution to define a document fuzzy set (see 410, FIG. 4).

An example of transforming a normalized frequency of occurrence of a text object's features is illustrated in **Figure 9** (see also Appellant's specification page 12, lines 11-17) to define membership in the document class fuzzy set illustrated Appellant's **Figure 10** (see also Appellant's specification page 13, lines 2-8) where the horizontal axis of Figures 9 and 10 represents the features considered (e.g., words), and where in Figure 9 the vertical axis denotes the frequency of occurrence of a feature f_i in the fuzzy set, and where in Figure 10 the vertical axis denotes the membership value of feature f_i in the fuzzy set.

As detailed in Appellant's **Figure 13** (see also Appellant's specification page 20, line 27 to page 23, line 9), once the document class fuzzy set is defined, *a degree of match* is measured between each *class fuzzy set* (i.e., each fuzzy set of a class of documents) and the document class fuzzy set (see 1302, FIG. 13). This aspect is illustrated in Appellant's **Figure 14** (see also Appellant's specification page 21, lines 4-19), which graphically depicts an example of max-min strategy that is used to measure the degree of match between one class fuzzy set and the document fuzzy set. The degree of match is then used to assign the text object a label that satisfies a selected decision making rule (see 1306, FIG. 13).

5.B Summary of Granule Feature Embodiment

In the second embodiment (as recited in independent claims 11 and 28), feature values defined over the normalized frequency domain of zero to one interval are represented using granule fuzzy sets. "A granule fuzzy set is a set of granules and corresponding membership values, where each granule is represented by a fuzzy set and an associated (word) label" (see Appellant's specification at page 13, lines 15-17).

By way of background, returning to the first or class fuzzy set embodiment which concerns fuzzy sets. **Figure 2** illustrates an example of a fuzzy set for the *feature* "temperature" in the "warm" fuzzy set (see Appellant's specification page 6, lines 3-14). Thus according to the fuzzy set shown in Figure 2, a given feature value along the x-axis has a corresponding membership value in the "warm" fuzzy set that is given along the y-axis (e.g., the temperature value 20 has a corresponding membership value of 1).

In contrast, the second or granule feature embodiment concerns granule fuzzy sets. **Figure 11** illustrates a granule fuzzy set for frequency values along the x-axis of the feature "transaction", which has been partitioned over three fuzzy sets (i.e., small, medium, and high). That is, the feature space for "transaction" is partitioned into three regions. For example, given the frequency value of 0.8 for the word "transaction", the corresponding membership value "small" is 0.3, "medium" is 1, and "high" is 0. (See Appellant's specification page 13, line 22 to page 14, line 14.)

With this background, the second or granule feature embodiment is summarized in Figure 19. (See Appellant's specification page 28, lines 3-12.) In this embodiment, a document granule feature fuzzy set is constructed for each new document or text object input to the classification system (see 1908 and 1910, FIG. 19), the details of which are set forth in **Figure 20** (see also Appellant's specification page 28, lines 14-22) and include: (a) extracting a set of granule features from the text object (see 2002, FIG. 20), and (b) constructing a granule feature fuzzy set for each feature of the text object (see 2008, FIG. 20).

Subsequently, a class label is assigned to the text object using approximate reasoning to categorize the document (see 1912, FIG. 19), the details of which are set forth in **Figure 21** (see also Appellant's specification page 28, line 24 to page 29, line

24) and include: (a) computing a degree of match between each class granule feature fuzzy set and the document granule feature fuzzy set (see 2102, FIG. 21), (b) aggregating individual degrees of matches to define an overall degree of match (see 2104, FIG. 21), and (c) using the overall degree of match for each feature to assign the text object a class label that satisfies a selected decision making rule (see 2108, FIG. 21).

6. Issues

The single issue presented herein is whether claims 1-13, 15-22 and 25-29 are unpatentable under U.S.C. §102(e) (or alternatively under 35 USC §103(a)) over Shetty et al., US 2003/0046253 A1 (hereinafter referred to as "Shetty").

7. Grouping of Claims

The claims do not stand or fall together as a group and are grouped as follows:

FIRST GROUP: Independent claims 1 and 22 and dependent claims 2-4, 6-10, and 25-27 define a first group of claims that for reasons discussed below stand or fall together.

SECOND GROUP: Claim 5, which depends from claim 1, stands on its own in a second group for reasons discussed below.

THIRD GROUP: Independent claims 11 and 28 and dependent claims 15-21 and 29 define a third group of claims that for reasons discussed below stand or fall together.

FOURTH GROUP: Claims 12-13, which depend from claim 11, define a fourth group of claims that for reasons discussed below stand or fall together.

8. Argument

Appellant traverses the final rejection of claims 1-13, 15-22 and 25-29 under 35 U.S.C. §102(e), or in the alternative 35 U.S.C. §103(a), as being unpatentable over Shetty, and submits for the reasons set forth below that Appellant's claimed invention is patentably distinguishable over Shetty.

A. Brief Summary of Shetty's Fuzzy Logic Approach to Clustering Data

Shetty discloses a neuro/fuzzy hybrid approach to *clustering* data. In particular, Shetty discloses a technique for clustering data in which: samples of a predetermined window length are received. The sample data is checked for uncertainty and/or robustness. The data is then clustered based on the outcome of the checking (see paragraphs 0009 – 0011 of Shetty). Shetty discloses that the data may be clustered using either a fuzzy logic approach (see paragraphs 0048 through 0078) or an unsupervised learning approach (see paragraphs 0079 – 0097).

Shetty outlines in paragraph 0102 a summary of a fuzzy logic approach for clustering input data, which is disclosed in more detail in Figure 2 and in paragraphs 0048-0078.

> In some embodiments, analyzer 560 clusters the read data using a fuzzy logic approach by forming a compatibility relationship matrix including the read data using a distance function such that the value obtained using the distance function is between 0 and 1. Analyzer 560 then finds a transitive closure of the formed compatibility relations matrix, and computes a threshold value based on the read data to set granularity for the clustering, and further forms a binary tree including hierarchical clusters from the found transitive closure, and builds clusters based on the formed binary tree and outputs the clustered data 580.

B. All Groups Of Claims Are Patentable Over Shetty

Shetty fails to disclose or suggest Appellant's claimed invention as a whole because Shetty concerns a fuzzy logic approach for *classifying data into clusters* (see Shetty paragraph 0002), while Appellant's approach concerns fuzzy logic approaches for *categorizing data into classes* (see Appellant's specification page 1, line 24 through page 2, line 2). That is, Appellant disagrees with the assertion in the Advisory Action that "assigning data to a predefined set of groups is synonymous with Shetty's clustering data in to groups" (see point 3 on page 2 of the Advisory Action). The difference being that clustering does not rely on a predefined grouping, but categorization does.

Another way to look at Shetty's clustering and Appellant's categorization is that clustering forms a basis for categorization. That is without clusters, there are no categories. More specifically, the approach disclosed in Shetty does not presume any pre-existing knowledge base of fuzzy sets. In contrast, Appellant's invention set forth in each independent claim concerns fuzzy logic approaches for classifying a text object into one or more classes using a knowledge base that records either a plurality of class fuzzy sets or a plurality of granule feature fuzzy sets. Accordingly, Appellant submits the claims of each group for this reason and the reasons discussed in detail below are patentably distinguishable over Shetty.

C. The First Group Of Claims Is Patentable Over Shetty

For the purpose of discussion presented herein with regard to the first group of claims, which includes independent claims 1 and 22, claim 1 is discussed as a representative claim. In rejecting independent claims 1 and 22, the Office Action on pages 3 and 9 alleges that the subject matter of the claimed invention is anticipated in view of the disclosure in Shetty at paragraphs 0003, 0005, 0006, 0025, 0048, 0050, and 0102. Appellant respectfully disagrees. In particular, paragraph 0102, reproduced above in Section B, summarizes Shetty's "fuzzy logic approach" to *clustering data*.

Unlike the fuzzy logic approach to *clustering* data disclosed in Shetty, Appellant's independent claim 1 recites a method for *classifying* a text object by constructing a *document class fuzzy set* with a plurality of features extracted from a text object, *where the document class fuzzy set is computed by transforming a normalized frequency of occurrence of features in the text object.* Each extracted feature has a degree of membership in the document class fuzzy set and a plurality of class fuzzy sets of a knowledge base. A degree of match is measured between each of the plurality of class fuzzy sets and the document class fuzzy set. The measured degree of match is then used to assign the text object a label that satisfies a selected decision making rule.

In asserting that Appellant's invention recited in claim 1 is anticipated by Shetty, the Office Action sets forth "Examiner's Notes" on page 3 and "Examiner's Response" on page 12, and supplemental reasons in the Advisory Action on page 2, which Appellant addresses below in sections C.1 – C.3 as they apply to Appellant's claimed invention recited in independent claim 1.

C.1 Appellant's construction of a document fuzzy set is *not* synonymous with Shetty's fuzzy logic approach to clustering read data

Appellant respectfully disagrees with the Office Action's assertion that Shetty's fuzzy logic approach to clustering read data is synonymous with constructing a document fuzzy set as claimed by Appellant (see Examiner's Note in the Office Action, on page 3, lines 7-8, which refers to paragraph 0102 of Shetty). Shetty in paragraph 0102 clearly states that clusters are developed from read data using the following series of steps (1) forming a compatibility relationship matrix *including the read data using a distance function*, (2) finding a transitive closure of the matrix, (3) computing a threshold to set a granularity for clustering, (4) forming a binary tree from the transitive closure, and (5) building clusters based on the binary tree.

Appellant's invention recited in independent claim 1 does not concern the clustering of input data as described by Shetty, instead Appellant's invention recited in claim 1 concerns classification which involves the construction of a document fuzzy set with a *plurality of features extracted from a text object* by: calculating a frequency of occurrence for each feature in the set of features in the text object; normalizing the

frequency of occurrence of each feature in the set of features; and transforming the normalized frequency of occurrence of each feature in the set of features to define the document class fuzzy set.

Thus, Appellant submits that Shetty neither discloses nor suggests constructing a document class fuzzy set for a text object by transforming a normalized frequency of occurrence of each feature in a set of features extracted from the text object. Instead the method disclosed by Shetty describes clustering data using a binary tree formed by computing a compatibility relationship matrix including read data using a distance measurement and from which a transitive closure of the matrix is found.

Furthermore, Shetty neither discloses nor suggests using a *document class fuzzy set* to categorize a document as claimed by Appellant. This aspect of Appellant's claimed invention is illustrated in the example shown in Figure 14, which graphically depicts an example of measuring the degree of match between one class fuzzy set and the document fuzzy set. Instead, Shetty concerns clustering data into groups, as opposed to, assigning data to a predefined set of labels. This is shown in the "crab example" disclosed in Shetty's paragraphs 0075-0078, which data is made up of "200 input values" (see Shetty paragraph 0022). In the Shetty crab example, the read data or input values define the clusters identified at paragraphs 0075-0078.

If categorization were performed in Shetty, the read data would be associated with existing groups or the existence of "a plurality of class fuzzy sets" in a knowledge bases as claimed by Appellant. Appellant submits that Shetty fails to disclose or suggest a method for categorizing data because Shetty is limited to disclosing how to arrange input data into clusters, but not how to label input data given a predefined set of labels. Thus, Appellant submits that Shetty must fail to discloses or suggest constructing a document class fuzzy set with features extracted from a text object that have a degree of membership in a plurality of class fuzzy sets of a knowledge base as recited by Appellant in independent claim 1.

C.2 Shetty's set of clusters fail to represent Appellant's knowledge base

Appellant respectfully submits that a set of clusters of input values disclosed by Shetty does not represent "a plurality of sets of class fuzzy sets of a knowledge base"

as claimed by Appellant (see Examiner's Note in the Office Action, on page 3, line 11). The clusters of input values identified using the method described in Shetty involves grouping input values, as noted above, into a set of clusters. Also as set forth above, class fuzzy sets are not synonymous with clusters. Furthermore, Shetty discloses in paragraph 0048 the use of a compatibility relationship matrix that is computed using a distance function. In contrast, Appellant makes use of a plurality of class fuzzy sets of a knowledge base to measure the degree of match with a document class fuzzy set.

Appellant thus respectfully submits that Shetty fails to discloses or suggests measuring a degree of match between a plurality of class fuzzy sets and a document fuzzy set, where the degree of match is thereafter used to assign a class label to the document fuzzy set, and where the document fuzzy set is constructed by transforming a normalized frequency of occurrence of features extracted from a text object, as claimed and disclosed by Appellant. That is, Shetty's clustering data into multiple clusters fails to disclose or suggest the creation of multiple sets of clusters which are then matched against a document set of clusters to classify the document set of clusters, where each cluster is labeled.

C.3 Membership in Shetty's clusters does not disclose or suggest Appellant's construction of a document fuzzy set

Unlike Shetty's fuzzy logic approach for clustering data, Appellant's invention as recited in claim 1 includes constructing a document class fuzzy set (see Examiner's Note in the Office Action, on page 3, lines 18-19). Specifically, Appellant's claim 1 recites that a document class fuzzy set is constructed by: calculating a frequency of occurrence for each feature in the set of features in the text object; normalizing the frequency of occurrence of each feature in the set of features; and transforming the normalized frequency of occurrence of each feature in the set of features to define the document class fuzzy set. However, as noted above in the discussion of Shetty's crab example, clusters do not identify how frequently input data occurs, they identify groups of input data.

The Advisory Action in point 6 on page 2 alleges that "to one of ordinary skill in the art, groups of data (cluster of N items) identify the frequency of occurrence to that

specific cluster by the N items involved". While this may be true in some situations, the reasoning is misplaced with respect to the clustering method disclosed in Shetty. Referring again to paragraph 0048 in Shetty, clusters as disclosed by Shetty are formed using a compatibility relationship matrix that is computed using a distance function. That is, clustering in Shetty is based on a *distance measurement* and not by *transforming* a normalized frequency of occurrence of each feature in a set of features to define a document class fuzzy set as claimed by Appellant.

C.4 In Summary

Accordingly for the reasons set forth above, Appellant submits that claim 1, representative of group 1, is patentably distinguishable over Shetty. In addition, it should be noted that independent claim 22 contains the same or very similar limitations to those discussed above with respect to claim 1, and therefore the argument presented above with regard to claim 1 applies equally to independent claim 22.

Also with regard to dependent claims 2-4, 6-10, and 25-27 of the first group, these claims depend directly or indirectly from independent claim 1 and thus contain all limitations of claim 1. Accordingly, the argument presented in this section with regard to independent claim 1 applies equally to it dependent claims.

D. The Second Group Of Claims (Which Depends From The First Group) Is Patentable Over Shetty

Appellant respectfully submits that claim 5 forming the second group when read as a whole with independent claim 1 is patentably distinguishable over Shetty which provides in addition to the limitations of claim 1 discussed above, the limitation of filtering the set of features extracted from a text object to reduce the number of features in the set of features.

In rejecting claim 5, the Office Action on the bottom of page 4 and top of page 5 alleges that Appellant's limitation in claim 5 is anticipated by paragraph 0044 of Shetty and that "the use of thresholding is a specific technique of filtering". Appellant respectfully disagrees as Shetty is silent as to the filtering of features of text objects.

Instead, paragraph 0044 of Shetty discloses that "the clustering approach to be used is determined based on comparing variation in the computed sum of variance with a predetermined variance threshold value". Paragraph 0044 of Shetty thus describes using a variance threshold to determine whether to use a unsupervised learning or a fuzzy logic approach to cluster data. Accordingly, Shetty fails to disclose or suggest filtering features of a text object to reduce the number of features in the text object, as claimed by Appellant.

Accordingly, for these reasons and for the reasons set forth above regarding independent claim 1, Shetty fails to disclose the limitations set forth in claim 5, which incorporates all limitations of claim 1. Claim 5 is therefore believed to be patentably distinguishable over Shetty.

E. The Third Group Of Claims Is Patentable Over Shetty

For the purpose of discussion presented herein with regard to the third group of claims, which includes independent claims 11 and 28, claim 11 is discussed as a representative claim. In rejecting independent claims 11 and 28, the Office Action on pages 6-7 and 10-11 asserts independent claims 11 and 28 are anticipated by the paragraphs 0005, 0006, 0047, 0048, 0073, 0094, 0095, and 0102 of Shetty. In particular, paragraph 0102, which is reproduced above, summarizes Shetty's "fuzzy logic approach" to *clustering data.* Furthermore in asserting claim 11 is anticipated by Shetty, the Office Action sets forth "Examiner's Notes" on pages 6-7 and "Examiner's Response" on page 13 of the Office Action, and the Advisory opinion on page 2 point 8, which Appellant addresses below as they apply to Appellant's claimed invention recited in independent claim 11.

Unlike Shetty, Appellant's invention recited in independent claim 11 is directed at a method for classifying a text object by computing a degree of match between each of a plurality of class *granule* feature fuzzy sets and a document *granule* feature fuzzy set to provide a degree of match for each ones of the granule features of the text object, and then *aggregating* each degree of match of the ones of the granule features to define an overall degree of mach for each feature of the text object.

Appellant submits that the fuzzy logic clustering method described by Shetty fails to disclose or suggest categorizing a document using granule features as claimed by Appellant (see Examiner's Note in Office Action, on page 6, lines 11-12, and Examiner's response on page 13 of the Office Action). Instead, the "granularity of clustering" referred to by Shetty in paragraph 0073 concerns setting a threshold value to limit cluster size. In contrast, Appellant's invention as recited in independent claim 11, concerns the extraction of "granule features" (e.g., words) from a text object, where each granule feature is represented by a plurality of fuzzy sets and associated labels (see for example Appellant's Figure 11, and description in section 2.A.1.c "Granule Fuzzy Set Feature Extraction" starting on page 13, line 9 of Appellant's specification).

Moreover, Shetty's reference to "granularity of clustering" in paragraph 0073 fails to disclose or suggest as claimed by Appellant in independent claim 11: constructing a document granule feature fuzzy set; aggregating each degree of match of a plurality of ones of the granule features to define an overall degree of match for each feature; and using the overall degree of match to assign the text object a class label. That is, Appellant's use of granule feature fuzzy sets is not to "set the granularity for [] clustering" as Shetty describes in paragraph 0073 as Appellant's claimed invention does not concern clustering but instead classification. That is, as described by in Appellant's specification and illustrated in Appellant's Figure 11, granule fuzzy sets partition a feature over multiple fuzzy sets (see Appellant's specification page 13, line 22 to page 14, line 14.). Furthermore, as claimed by Appellant, once a degree of match is computed between granule features, they are aggregated to define an overall degree of match for each feature. Shetty thus fails to discloses or suggests representing features of input data with a plurality of granule feature fuzzy sets where each degree of match of ones of the granule features are aggregated to define an overall degree of match as claimed by Appellant.

Accordingly for the reasons set forth above, Appellant respectfully submits that independent claim 11 is patentably distinguishable over Shetty. In addition, it should be noted that independent claim 28 contains the same or very similar limitations to those discussed above with respect to claim 11, and therefore the argument presented above with regard to claim 11 applies equally to independent claim 28.

Also with regard to dependent claims 15-21, and 29 of the third group, these claims depend directly or indirectly from one of independent claims 11 or 28 and thus contain all limitations of the claims from which they depend. Accordingly, the argument presented in this section with regard to independent claims 11 and 28 applies equally to those dependent claims.

F. The Fourth Group Of Claims (Which Depends From The Third Group) Is Patentable Over Shetty

For the purpose of discussion presented herein, claim 12, which depends from claim 11, is discussed as a representative claim of the fourth group, which includes dependent claims 12 and 13, where claim 13 depends from claim 12.

In rejecting claims 12, the Office Action alleges on page 7 that Appellant's limitation in claim 12 is anticipated by paragraphs 0006, 0073, 0094, and 0102 of Shetty and that "feature fuzzy sets are in essence scaled by the degree of granularity". Appellant respectfully disagrees as Shetty is silent as to the filtering of features of text objects. Instead, paragraphs 0006, 0073, 0094, and 0102 of Shetty discloses that a "threshold value is used to set the granularity of clustering". These paragraphs of Shetty thus describes how a threshold value can be used to limit the number of clusters computed. Accordingly, Shetty fails to disclose or suggest filtering granule features of a text object to reduce the number of granule features in the text object, as claimed by Appellant.

Accordingly, for these reasons and for the reasons set forth above regarding independent claim 11, Shetty fails to disclose or suggest the limitations set forth in claim 12, which incorporates all limitations of claim 1. Claim 11 is thus believed to be patentably distinguishable over Shetty. Insofar as claim 13 is concerned, claim 13 depends from now presumably allowable dependent claim 12 and is also believed to be patentably distinguishable over Shetty.

9. Conclusion

Based on the arguments presented above, claims 1-13, 15-22 and 25-29 are believed to be in condition for allowance. Appellant therefore respectfully requests that the Board of Patent Appeals and Interferences reconsider this application, reverse in whole the decision of the Examiner, and pass this application for allowance.

Respectfully submitted,

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Date: September 10, 2004